HEPAP SUBPANEL

Questions for the Community

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Snowmass

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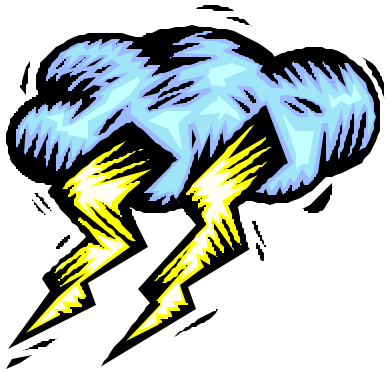
HEPAP SUBPANEL

- Charge & Membership
- Planning Process
- Questions for the Community

Web site:

http://hepserve.fnal.gov:8080/doehep/lrp_panel/index.html

CHARGE



With the completion of the Large Hadron Collider in the middle of this decade, the United States will no longer have a facility operating at the energy frontier, where critical discoveries are likely to be made.… Therefore, it is timely for the U.S. program to examine its long-term research directions and needs in terms of maintaining its traditional role among the world leaders in HEP research.

CHARGE

[We] are charging the subpanel to ... produce a national roadmap for HEP for the next twenty years.… [The] subpanel should weigh the scientific promise and programmatic importance of both accelerator and non-accelerator based efforts.… [The] plan should indicate what funding levels the roadmap would require (including possible construction of new facilities), and what the impacts and priorities should be if the funding available provides constant level of effort (FY 2001 President's Budget Request) into the outyears (FY 2002-2022).

1. MAJOR INTELLECTUAL CHALLENGES & SCIENTIFIC APPROACHES

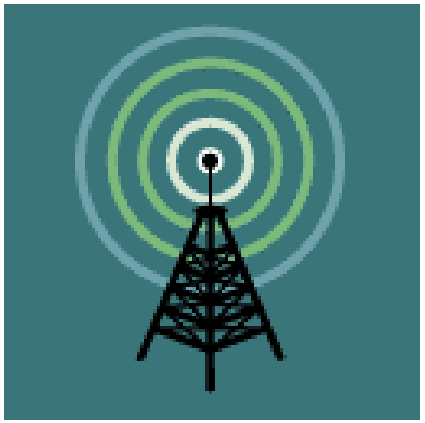
What are the central questions that define the intellectual frontier of HEP? The reach of the subpanel's considerations should include the accelerator-based particle physics program, related activities in astrophysics and cosmology, theory, and the proper balance of these elements. Describe these questions in relation to the tools, existing and new, required to effectively explore them.

2. STRATEGY REGARDING THE ENERGY FRONTIER

The leading discovery tool in HEP in the 20th century, and as far into the future as one can see, is the energy frontier accelerator/ storage ring. In the context of the worldwide scientific effort in particle physics, formulate a plan that optimizes the U.S. investment of public funds in sustaining a leadership role at the high energy frontier, including a recommendation on the next facility that will be an integral part of the U.S. program.

3. MEETING TECHNOLOGY CHALLENGES

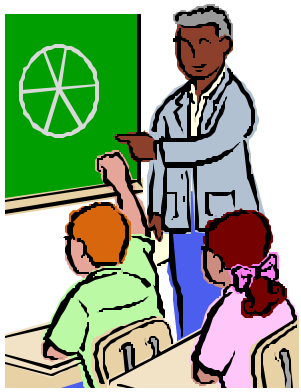
Identify technology developments essential for new instruments and facilities required to address the central questions noted above, and how these developments are captured in R&D plans. Explain the connection and importance of these R&D activities to the U.S. HEP program over the 20-year span of the plan developed by the subpanel.



4. BROAD IMPACTS AND INTELLECTUAL RENEWAL OF HEP

Summarize the wide-ranging impacts of the field on society; and recommend ways in which the excitement and the broad, long-term benefits of HEP can be maintained and conveyed to students at all levels, to society at large, and to government.

The report is due by the end of the year.



MEMBERSHIP

We asked the community to suggest members. We contacted

- American Physical Society
  - DPF, DPB, DAP, DNP, TGG
- Users Organizations
  - FNAL, SLAC, BNL, Cornell
- Laboratory Directors

We received hundreds of nominations.

We tried to balance the membership

- Particle Physics – Astrophysics – Nuclear Physics
- Theory – Experiment – Accelerator
- Hadrons – Leptons
- High Energy – High Intensity
- University – Laboratory
- Age – Geography – Gender – Ethnicity

All members are expected to look beyond their local interests and craft a plan for the good of the field as a whole.

SUBPANEL

Jonathan Bagger – Co-Chair
Johns Hopkins

Barry Barish – Co-Chair
Caltech

Paul Avery
Florida

Janet Conrad
Columbia

Persis Drell
Cornell

Glennys Farrar
NYU

Larry Gladney
Pennsylvania

Don Hartill
Cornell

Norbert Holtkamp
Oak Ridge

George Kalmus
Rutherford Appleton

Rocky Kolb
Fermilab

Joseph Lykken
Fermilab

SUBPANEL

William Marciano
BNL

John Marriner
Fermilab

Jay Marx
LBNL

Kevin McFarland
Rochester

Hitoshi Murayama
UC, Berkeley

Yorikiyo Nagashima
Osaka

Rene Ong
UC LA

Tor Raubenheimer
SLAC

Abraham Seiden
UC, Santa Cruz

Melvyn Shochet
Chicago

William Willis
Columbia

Fred Gilman (Ex-Officio)
Carnegie Mellon

PREVIOUS STUDIES

The subpanel is building on the work of previous studies, including

- 1994 Drell HEPAP Subpanel
- 1998 Gilman HEPAP Subpanel
- 1998 Winstein NRC Panel
- 2000 HEPAP White Paper

OUTREACH

The panel has met with representatives of related fields, including

- Astrophysics, cosmology and nuclear physics

It will make contact with the international community during Snowmass, including the directors of

- CERN, DESY, KEK

It will also meet with representatives of the Asian and European communities.

MEETINGS

The panel held a series of meetings where it heard presentations of the major scientific programs. It also held town meetings to receive advice from the community and senior leaders in the field.

- Gaithersburg, Maryland, March 28-29, 2001
- Brookhaven National Laboratory, April 19-20, 2001
- Stanford Linear Accelerator Center, May 23-24, 2001
- Fermi National Accelerator Laboratory, June 11-12, 2001

MEETINGS

The panel will meet at the beginning and end of Snowmass.

The Snowmass Summer Study comes at an excellent time!

- Snowmass, July 1-3 and July 17-20, 2001
- Washington, D.C., August 16-18, 2001
- Santa Fe, September 9-14, 2001 (Final Meeting)

In Washington we will hear summary reports on Snowmass. We will have that session web cast. Stay tuned …

No conclusions will be reached until after Snowmass!

APPROACH TO PLANNING

- Start with an open dialog ...
  - Listen to presentations
  - Ask questions, begin discussions
- Continue with a systematic process ...
  - Identify physics opportunities
  - Evaluate experiments and facilities needed to accomplish science goals
  - Work in an international context, considering priorities and initiatives of other countries

APPROACH TO PLANNING

- Prioritize where possible
  - Very large facilities (billions $$)
  - Medium facilities (hundreds of millions $$)
- Develop a viable long range plan …

  … within technical, political and fiscal realities

THE RESULT

The final result will be a plan for the future of U.S. high energy physics. It will

- Make the intellectual case for the field, in the broadest possible terms;
- Explain what it takes to address the scientific questions we face;
- Lay foundations for the global cooperation that the next machine will require;
- Generate a coherent plan for American particle physics in and beyond the LHC era

QUESTIONS TO THE COMMUNITY

To reach the goal, we need your help! The panel is posing a set of questions to the community.

These are questions with which we are grappling.

- Send a letter to panel@pha.jhu.edu
- Talk to us during the next three weeks
- Meet with us on the afternoon of July 17
  - Sign up via the web …

QUESTIONS

What is the scope of particle physics?

The intellectual scope of the field has broadened.

Today, the main themes include –

- The nature of matter and energy
- The structure of space and time
- The origin and evolution of the Universe

How do we now describe our field ??

QUESTIONS

What are the most important scientific questions facing the field?

The main thrust of the next few years –

- Understand electroweak symmetry breaking
- Investigate the origin of CP violation
- Measure neutrino masses and oscillations

What else ?? What are the scientific priorities that will drive our field for the next 20 years ??

QUESTIONS

What tools and approaches are required to address these questions?

The main tools and approaches include

- New collider experiments/facilities
- Upgrades to existing experiments/facilities
- Experiments/facilities away from accelerators

What do we need to address our science questions ??

QUESTIONS

Does the science require a major new facility?

Major new facilities being proposed include –

- Linear Colliders
- Neutrino Factories / Muon Colliders
- Very Large Hadron Collider

These are multibillion dollar facilities. Is the scientific case strong enough for the world community to pursue any of these projects ??

QUESTIONS

If so, should the U.S. bid to host it? What are the advantages and disadvantages? How might the disadvantages be mitigated?

- What are the costs and benefits to the host country?
- How should the U.S. structure its program if the next major facility is built here? Or abroad?

Should the U.S. bid to host a new major facility ??
Why or why not ??

QUESTIONS

What are the essential elements of a successful international partnership? How should it be implemented?

- How should we create an international partnership?
  - Management structure ?
  - Role of the host country ?
  - Criteria for cost sharing ?

How can an effective international partnership be formed ??

QUESTIONS

What is the role of astroparticle physics and cosmology in the field?

- National Underground Laboratory
- New experiments in space
- New generation of proton decay, dark matter and solar neutrino experiments

Astroparticle physics has emerged as a vital part of our field. How should we view experiments in this area ?? How should we support them and set priorities ??

QUESTIONS

What is the relation between particle physics and other fields of science and technology?

- Connections to astrophysics, cosmology, nuclear physics and cosmic ray physics?
- Applications of instrumentation and particle detection techniques to other fields?
- Uses of accelerators and acceleration techniques in other fields?

What are the connections between particle physics and other fields ?? How do they benefit from each other ??

QUESTIONS

What are the important issues facing university groups? What is their role in the future evolution of the field?

- What is the present role of universities to the field ?
  - Intellectual and educational
- How can we enhance university infrastructure and support?

The university program has been at heart of high energy physics in the U.S. What are the problems and opportunities that universities face ?? What changes should be made ??

QUESTIONS

What are the most pressing R&D goals for accelerators and detectors?

- What accelerator R&D is needed to develop the next generation of accelerators? What are the highest priorities?
- What detector R & D is needed for the next generation of experiments? How should it be supported and prioritized?

Significant R&D funding is needed for any new accelerator. We need to make the proper arguments. What are they ??

QUESTIONS

What does particle physics offer to society?

- Knowledge
- Education
- Technology
- Leadership

A large investment in science requires very strong arguments. What are they ??

QUESTIONS

What are the contributions of our field to other areas of science and technology?

- Medicine and Biology
- Electronics and Advanced Computing
- WWW
- ???

Which areas of science have advanced as a result of high energy physics ?? Which technologies ?? Which technologies have been transferred to industry ??

QUESTIONS

How do accelerator and detector R&D benefit society?

- Applications to other fields of physics or science?
- Applications to medicine or other needs of society?

Particle physics plays a leadership role in developing new accelerator techniques, as well as new particle detection and data analysis tools. How does this benefit society ??

QUESTIONS

What should the particle physics community do differently?

- Roles of the national laboratories?
- Sociology of enormous collaborations?
- Publication and size of author lists?
- Education for graduate students?
- Recruitment of the best young scientists?

What should we do to improve the way we do research in particle physics ??

CONCLUSIONS

- **The field has been very productive in recent years**
  - Precision tests of electroweak theory
  - Neutrino oscillations
- **The coming years look very bright**
  - Electroweak symmetry breaking
  - CP violation
  - Neutrino masses and mixings
- **Promising opportunities for a long range plan**
  - Balancing act ……
    - Ambitions, opportunities and reality
  - Require tough choices and priorities to
    - Develop a program the community wants
    - Create a program we can sell!